

PERSONALIZED MEDICINE USING AI AND MACHINE LEARNING

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ABSTRACT

Healthcare now has more options thanks to the development of artificial intelligence (AI) and machine learning (ML), especially in the area of personalized treatment. Even with the incredible advances in medical research, problems like drug mistakes, postponed therapy, incorrect diagnoses, and overtreatment still exist and lead to poor patient outcomes and higher death rates. By combining genetic, environmental, and lifestyle factors to customize therapies, precision medicine—which is focused on the unique characteristics of each patient—offers a possible answer to these problems. This study delves into current research on the use of AI/ML in precision medicine, with a particular emphasis on genomics and predictive diagnoses. Research shows how AI/ML algorithms can be used to analyze genomic data and provide individualized treatment plans and earlier treatments for a range of disorders. Precision medicine is about to enter a new era where patient care and treatment outcomes can be transformed by the integration of AI/ML with healthcare data.

Keywords: Precision medicine, Artificial intelligence, Machine learning, Genomics, Personalized treatment.

1. INTRODUCTION

Our search for knowledge has taken us on incredible journeys throughout the years. Antibiotics, which were just developed in the previous century, have saved countless lives by eradicating once-feared diseases. Nevertheless, utilizing search query phrases such as 'medication error' and 'delayed treatment', over 130,000 research address pharmaceutical errors and over 450, 000 incorporate delayed treatment in the context of current published literature (e.g., accessible through PubMed). However, the issue of individuals losing their lives due to medical mistakes has been mostly overlooked and unrecognized. The new medical revolution is about to begin, and it will be just as massive and far-reaching as the last one. There is still a lot of medicine that relies on relieving symptoms and conducting learning trials based on therapies, even though we know better. This approach helps most patients, but it doesn't work for everyone. Knowing the interrelationships of diseases can shed light on their pathophysiology, etiology, and classification. We live longer because of several things, including advances in medicine, surgery, and mental

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health treatments. Unfortunately, it is currently a time-consuming and error-prone process to provide patients with the right treatment plan at the right time based on their current prescription list and drug allergies. The need for medication reconciliation software has grown in tandem with the number of prescriptions and drug consumption. Additionally, there are a lot of problems with healthcare that people face on a daily basis, such as incorrect diagnoses, unnecessary treatments, low productivity, wasted clinical data, and a lot of money.

Using new information technology at each stage of care can drastically cut down on these errors. Among the top three killers, following cancer and heart failure, medical mistakes rank third (2). Medical mistakes kill between 180,000 and 250,000 Americans annually, according to new research (2). The existing medical system's expanding complexity and declining quality—including communication breakdown, incorrect diagnoses, poorly coordinated care, and rising costs—has contributed to this rising number. Recent years have seen the rise of precision medicine as a promising new paradigm in patient care and an important innovation pillar for pioneering studies aimed at revolutionizing health. An intelligent integration of multi-omics profiles with clinical, imaging, epidemiological, and demographic details could lead to a plethora of earlier interventions for advanced diagnostics and the tailoring of better, more cost-effective personalized treatment; this could revolutionize the conventional, symptom-driven practice of medicine. This calls for a forward-thinking healthcare system that can help researchers and clinicians acquire a fuller picture of the patient; this includes not only medical history but also phenotypic data, lifestyle variables, and social determinants that influence treatment choices. Its primary tenet is the "4Ps" model of patient care, which stands for "Predictive, Preventive, Personalized, and Participatory." This model seeks to improve health outcomes by helping doctors better understand the role that individual differences in clinical data play in making accurate diagnoses and planning effective treatment plans. Although healthcare information utilization in clinical decision-making has been hindered by the intricacies of individual-level disorders, technological developments have alleviated some of the limitations. By integrating disparate data sources and discovering patient-specific patterns of disease progression to provide real-time decision support, electronic health records (EHR) can be a powerful tool for effective personalized and population health, which in turn can improve patient outcomes. Big data management presents significant obstacles, despite the undeniable importance of healthcare data mining.

2. LITERATURE REVIEW

Vadapalli et. al. (2022) studied on the consideration one of the most exciting medical endeavors of our day, precision medicine makes use of a patient's genetic makeup in conjunction with their environmental and lifestyle factors to improve the accuracy of disease diagnosis and treatment. One of the most intricate and data-rich aspects of precision medicine is the utilization of genetics. Using AI and ML techniques deftly, the current big challenge is to successfully integrate genetics into precision medicine that applies across varied populations, diverse

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diseases, and different ancestries. The purpose of this study was to examine and contrast the various AI/ML approaches employed in genomics and precision medicine with respect to their aims, methods, datasets, data sources, ethics, and gaps. We used PubMed Central to find and index high-quality articles published in the recent five years. Our search was limited to publications that detailed the use of artificial intelligence and machine learning algorithms in statistical and predictive studies of gene variations and expression utilizing whole genome and/or whole exome sequencing, RNA-seq, and microarrays, respectively. We did not restrict our investigation to any one data source or disease in particular. Using the parameters of our review and comparison analysis, we were able to locate 32 distinct AI/ML methods used in variable genomics research, and we present extensively modified AI/ML algorithms for disease prediction.

Sebastiani et. al. (2022) inspected complex sicknesses including psoriatic joint pain (public service announcement), foundational lupus erythematosus (SLE), and rheumatoid joint pain (RA), accuracy medication is viewed as profoundly pertinent. Clinical and serological heterogeneity, alongside the big number of comorbidities that can include these illnesses, as well as the rising information on their pathogenesis and enhancements in early analysis, keep on restricting the chance of individualizing treatment for these patients, in spite of the thrilling number of new atoms produced for their treatment. Regardless of the limited number of treatment decisions, varying simultaneous organ contributions in these issues might require an alternate way to deal with care. With regards to numerous rheumatic infections, treat-to-target treatment is as yet the focal point of contemporary remedial methods.

Khan et. al. (2020) studied the term "personalized medicine" refers to a relatively new approach to healthcare that bases interventions on specific patient traits instead of "one-size-fits-all" protocols. In order to make sense of and build prognostic models from the data contained inside ever-increasingly complex epidemiological datasets, robust methodologies like statistical machine learning and artificial intelligence (AI) are becoming essential. Machine learning's accurate predictions made possible by this type of study pave the way for personalized medicine. Personalizing care for patients with spine disease can also be greatly assisted by other AI tools like computer vision and natural language processing. In this article, we will go over the latest developments in using AI to study spinal cord injuries and degenerative spine diseases. We detail research that used AI to construct reliable prognostic models, mine medical data for useful information using NLP, and assess functional status at a finer level using computer vision. We have changed the game in spine care by showing how these innovations can pave the way for more individualized therapy through a case study.

3. AI & ML IN HEALTH INTELLIGENCE, PRECISION MEDICINE AND RESOURCE MANAGEMENT

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To facilitate the examination of dynamic secret elements in clinical information utilizing AI calculations, to get noteworthy hole based data about patients for early location and avoidance of protected messes like malignant growth, and to smooth out information sharing by creating productive correspondence across medical care units and logical labs, keen large information stages are fundamental. This will work on the quality and headway of medical care. Its likely use in medical care has the makings of a game-changing development that could upset customized and populace medication while giving various computational benefits. Late years have seen a plenty of man-made intelligence and ML-based drives focused on sickness understanding, with the objectives of working on prescient conclusion and, likewise, directing therapy factors; for example, making infection affiliations in view of clinical signs, electronic wellbeing records (EHRs), and information created by wearable innovation. Exploring commitments and contrasting various computer-based intelligence and ML guaranteed arrangements, methods, conversations, and continuous models distributed during the most recent 5 years permitted us to get a total rundown of the scholarly arrangements that are as of now accessible. Segment "Hypothetical foundation of computer-based intelligence and ML" and areas "Models in medical care and approaches" zeroed in on the valuable commitments of the man-made intelligence and ML calculations examined. A thorough and custom fitted summation of the strategies given is what we offer. In light of everything, the audit research and the artificial intelligence/ML commitments fall into three principal gatherings: Medical services Asset The executives, Moral Contemplations, and Accuracy Medication.

4. AI ALGORITHMS USED IN PERSONALIZED MEDICINE

Machine learning and artificial intelligence have many applications in healthcare, particularly in the area of personalized medicine. This article discusses a few of these algorithms.

4.1. Naïve Bayesian

The Naïve Bayesian (NB) algorithm, which was devised by Thomas Bayes (1702–1761), facilitates the principled capture of uncertainty in a model by determining the probability of various possibilities. The algorithm is based on a probabilistic model. NB is currently utilized in a variety of systems, including text classification, recommender systems, and spam filtering. Additionally, it finds utility in the fields of medicine and meteorology. Because of this, it is also an effective method for making predictions and classifications. A few benefits of NB include its reduced training data requirement and its robustness against input data noise. Among the many drawbacks of NB, as pointed out by, are the following: inaccuracies caused by the assumption of class conditional independence; and so on. Some drawbacks of Naïve Bayes include the following: if a predictor is missing from the training data, NB will presume that the record containing the new predictor category has 0% chance of being correct.

4.2. Artificial Neural Network

According to, artificial neural networks (ANNs) have a wide range of potential medical applications, such as in the following areas: imaging, back pain, dementia, appendicitis,

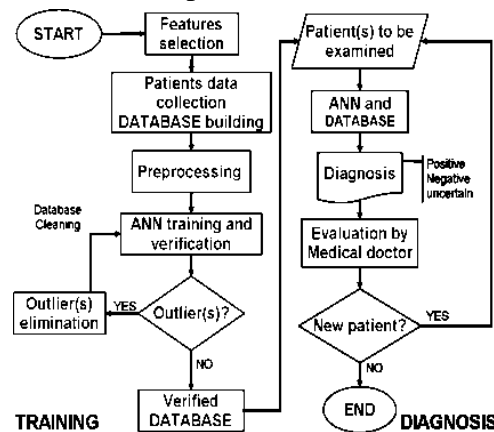
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myocardial infarction, acute pulmonary embolism, arrhythmias, and mental disorders.

According to, below are a few of the benefits of ANN: Both linear and non-linear models can be learned by neural networks. It is also possible to use statistics to evaluate the precision of models generated by neural networks. Neural networks can efficiently handle incomplete data and noise. Neural network models are adaptable to changing conditions, like those in the healthcare industry, because they can be easily modified.

Figure 1: Fundamental steps in ANN-based medical diagnostic



5. CONCLUSION

The integration of AI and ML into healthcare has ushered in a new age of personalized medicine, which has the potential to revolutionize both the way patients are treated and the results they achieve from their treatments. Despite significant advancements in medical understanding, the healthcare system is nevertheless plagued by problems such as medication errors, delayed therapy, inaccurate diagnosis, and overtreatment, leading to poor patient outcomes and higher death rates. The focus on individual patient characteristics, as opposed to generic treatment regimens, in precision medicine has tremendous potential for resolving these challenges. By tailoring treatments to specific patient groups according to lifestyle, environmental, and genetic variables, precision medicine hopes to increase diagnostic accuracy and therapeutic efficacy. For early interventions and personalized treatment plans to be supported by integrating multi-omics data with clinical information, AI and ML are crucial. The importance of artificial intelligence and machine learning in creating precision medicine has been demonstrated by new studies, particularly in genomics. Studies have shown that AI/ML algorithms can be useful for analyzing genomic data to make prediction diagnosis for various diseases. This could lead to more targeted and effective treatments.

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